CONTINGENCY PLAN FOR THE B&L LANDFILL

Prepared for:

Mr. Thomas E. Martin
Site Manager
Asarco Incorporated
P.O. Box 1677
Tacoma, WA 98402

Prepared by:

Hydrometrics, Inc.®
5219 North Shirley Street
Tacoma, WA 98407

June 2001

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF EXHIBITS

1.0 INTRODUCTION

This Contingency Plan for the B&L Landfill Site (Site) (see Figure 1-1-1) addresses issues presented by Ecology (Dom Reale) in its March 7, 2001 letter to Asarco (Thomas Martin). The letter initiated a series of document submittals that are part of the Site review process including:

- The Draft Review of Remedial Activities at the B&L Landfill (submitted May 1, Hydrometrics 2001a)
- This Draft Contingency Plan which includes a:
- Draft Wetland Soil and Ditch Sediment Sampling Plan
- Draft Site Perimeter Monitoring Well Plan.

This Contingency Plan addresses the possibility of contingency actions under Ecology Order No. DE-92TC-S214. In accordance with the schedule presented in Ecology's March 7, 2001 letter, this draft Contingency Plan will be implemented during late summer and fall of 2001.

1.1 REMEDIAL ACTIVITIES REVIEW SUMMARY

The B&L woodwaste site ("the Site") is located between Fife Way and the Puget Power access road approximately 400 yards south of their intersection in Milton, Washington. The Site is owned by Executive Bark, Inc. The Site was operated from the mid-1970's to 1984 primarily receiving deck debris from log sort yards in Tacoma, Washington. Deck debris consisted of:

- Woodwaste, primarily bark but also branches and chunks of wood;
- Log yard soils, which were often sandy/silty fill from dredging of waterways in the Tideflats; and
- Gravel-sized rock, including Asarco copper smelting slag which was used as ballast at the sort yards.

In 1982, the Commencement Bay Nearshore/Tideflats area was added to the National Priorities List (NPL) under the comprehensive Environmental Response Compensation and Liability Act of 1980. The NPL Site includes the Hylebos Waterway and other sites, including the B&L Landfill, that were believed to contribute contamination to the waterway.

Additional investigations of soil, groundwater, and surface water at the Site (see Section 2.2) led to development of a Final Cleanup Action Plan (CAP) for the Site in October 1991 (see Appendix A of the Review of Remedial Activities Report; Hydrometrics 2001a). The CAP identified a selected remedial alternative for the Site consisting of the following items:

1. Landfill consolidation
2. Multimedia (RCRA) cap or equivalent
3. Stormwater detention basin
4. Groundwater pumping/treatment as needed
5. Ditch remediation (excavation of contaminated sediments and backfill with clean sediments)
6. Landfill gas controls
7. Surface water controls
8. Institutional controls (fencing, groundwater and surface water monitoring, land and water use restrictions).

In December 1991, Ecology issued an Enforcement Order (No. DE 91TC-S267) to Murray Pacific, Executive Bark, and Asarco to develop preliminary designs for the remedial actions identified in the CAP. In June 1992, Ecology issued another Enforcement Order (No. DE-92TC-S214) for construction, operation and maintenance and monitoring of the selected remedial actions. Asarco took the lead in design and implementation of the remedial actions in coordination with the Site owner, Executive Bark, and with Murray Pacific. The Final Engineering Design Report (Hydrometrics, Inc., 1992a) was submitted to Ecology in April 1992 and the cleanup action was completed by fall of 1993. A Closure Report (Hydrometrics, 1994) summarizing implementation of the cleanup action and describing construction monitoring and compliance monitoring during the cleanup action was submitted to Ecology in May 1994.

Implementation/construction of the cleanup proceeded in four phases:

Phase I – Site Stabilization and Fill Water Monitoring

Phase II – Landfill Consolidation

Phase III – Gas Collection and Cover System

Phase IV – Completion

Phases I and II were completed by the end of 1992. Phases III and IV were completed in the summer and fall of 1993.

Phase I – Site Stabilization and Fill Water Monitoring included:

- installation of stormwater controls (detention pond, silt fencing);
- initial clearing and grubbing to establish a staging/decontamination area;
- installation of dewatering systems, when necessary, to control groundwater movement in work areas;
- construction of test pits to determine elevations of the silt layer upon which the fill water monitoring system was constructed; and
- installation of the fill water monitoring system (see Figure 1-1-2).

Phase II – Landfill Consolidation included:

- Soil excavation in the perimeter areas and consolidation into the landfill area.
- Performance monitoring in accordance with the Compliance Monitoring Plan (Appendix E of the Engineering Design Report, Hydrometrics, 1992a).

Phase III – Gas Collection and Cover System (see Figure 1-1-3) installation consisted of five layers including:

- 6 inches of hydroseeded class A topsoil on top;
- 18 inches of sandy pit run material (0.01 cm/sec minimum permeability);
- Geocomposite drainage net;

- 40 mil PVC liner; and
- Geosynthetic clay liner (sodium bentonite clay sandwiched between 2 geotextiles) on bottom.

Phase IV – Completion included all grading work necessary for construction of the perimeter road, access roads and permanent storm water controls, fencing and clean-up and re-vegetation of the perimeter area (see Figure 1-1-4).

A more detailed description of the landfill cleanup actions is in the Review of Remedial Activities Report (Hydrometrics 2001a). As required by WAC 173-340-410(1)(c), the B&L landfill cleanup action includes continued monitoring of surface water and groundwater on and peripheral to the Site to confirm the long-term effectiveness of the cleanup action. A Site Operation and Maintenance program is also in effect. The Review of Remedial Activities Report presents the results of long-term monitoring to date. The following is a brief summary of these results.

1.1.1 Soil

Investigation of Site soils were conducted during several efforts from 1985 through 1998. A remedial investigation identified six elements (antimony, arsenic, copper, lead, silver, and zinc) as typically associated with landfill materials and present in soils at concentrations above background levels. Performance monitoring showed that surface soil and ditch locations that were excavated achieved remediation levels.

1.1.2 Surface Water

The Site is located in a flat lowland area within the Puyallup Valley flood plain. Hylebos Creek is to the north of the Site. A series of drainage ditches surround most of the Site and drain both the Site and surrounding farmlands and a nearby apartment complex (see Figure 1-1-5). The ditches converge at the northwest corner of the site and form a single ditch. This ditch discharges into the Surprise Lake Drain which in turn discharges to Hylebos Creek. Hylebos Creek enters Commencement Bay through the Hylebos Waterway. Flow in the ditches around the Site is intermittent and occurs primarily during the wet season from November through April. During the wet season groundwater discharge to ditches may occur and account for a significant portion of wet season base flow.

Surface water quality samples from the ditches were collected before and after Site cleanup was completed. Surface water quality showed lower concentrations of arsenic and metals after cleanup; however, arsenic concentrations remained above cleanup levels for arsenic. Potential sources of arsenic concentrations in the ditches include:

- upgradient sources of groundwater and surface water associated with impacts from pesticides and herbicides used on upgradient agricultural fields;
- ambient natural groundwater concentrations in upgradient groundwater; and
- inflow to the ditches from saturated fill in the B&L landfill.

1.1.3 Groundwater

Interbedded fluvial sands & silts underlie the site and extend laterally to the upland boundary at the eastside of the landfill where glacial till is encountered (see Exhibit 1). A large marsh area borders the landfill to the north. Silty sand was encountered at shallow depths in most of the area. A fine-grained organic silt/peat layer lies beneath this shallow sand unit in most locations at depths of 12 to 18 feet. The silt-peat layers ranges from 0 to 6 feet in thickness and is underlain by fine to coarse-grained sand to depths of up to 40 feet.

The upper and lower sand units are the primary shallow water bearing units beneath the site. The potentiometric water levels for both the upper and lower sand units are close to or at the groundwater surface over most of the site. As a result, the lower 2 to 3 feet of wood waste within in the landfill appears to be saturated on a seasonal basis. Groundwater flow direction is generally towards the wetlands to the northwest of the site (see Figures 1-1-6 and 1-1-7). The hydrology of the shallow sand unit appears to be influenced by the presence of adjacent ditches and wetlands.

Prior to remediation, arsenic and iron were the most elevated metals with highest concentrations within the wood waste area. Investigations conducted subsequent to completion of the remedy showed concentrations in the landfill decreased significantly but remained elevated within the landfill system. Arsenic concentrations apparently extend from the landfill into groundwater in the wetland north of the landfill (see Figure 1-1-8). Subsequent investigation indicates the area of elevated arsenic concentrations is very localized and has shown little variability over time.

1.1.4 Post Remediation Operation and Maintenance

Operation and maintenance for the site consists of periodic inspections to detect any problems with the landfill cap and maintenance to correct any problems that arise. Site O&M inspections show the condition of the cap remains good with only incidental maintenance, such as vegetation control and removal of debris as necessary for the site.

1.2 CONTINGENCY PLAN SCOPE

This plan addresses comments in Ecology letter to Asarco dated March 7, 2001, and includes all the May 31deliverables including:

- Draft Wetland Soil and Ditch Sediment Sampling Plan
- Draft Site Perimeter Monitoring Well Plan
- Draft Contingency Plan that addresses any on-going release from the landfill.

Monitoring data presented in the Review of Remedial Activities Report (Hydrometrics 2001a) suggest migration of arsenic in groundwater may occur from the landfill. Other potential sources of arsenic include off-site sources of arsenic such as agricultural pesticides, ambient background arsenic concentrations, and residual concentrations in soils and groundwater from pre-cleanup conditions. Supplemental data collected as part of the soil sediment and monitoring well programs are necessary to confirm releases from the landfill are occurring, or to identify other non-landfill sources of arsenic in groundwater. Data and information obtained as part of the wetland and ditch sampling program, and as part of the perimeter monitoring well program will be used to develop, evaluate and implement contingency actions that address identified releases of contaminants from the landfill.

2.0 DITCH AND WETLAND SOIL SAMPLING PLAN

The objectives of the Ditch and Wetland Soil Sampling plan are to:

1. Establish metals concentrations in ditch sediments upstream and downstream of the landfill and use this data to evaluate whether there are post-remediation impacts to the downgradient ditch system from the landfill.
2. Delineate the lateral and vertical extent of impacted soils in wetland areas downgradient of the landfill.

This Ditch and Wetland Soil Sampling Plan addresses specific concerns identified by Ecology. In their March 7, 2001 letter to Asarco, Ecology indicated the need for re-testing sediments in the ditches adjacent to and downstream of the Site. Specifically, Ecology indicated a need for sampling the ditch system from the landfill to the confluence with the Surprise Lake Drainage, and additional sampling downstream of this confluence. Ecology also called for sediment sampling in Hylebos Creek, at and downstream of the confluence with the Surprise Lake Drainage.

As discussed in the Review of Remedial Activities report (Hydrometrics 2001a), there are other potential sources of arsenic in groundwater and sediments in this area. Sediment data from downgradient ditches will be difficult to interpret without some understanding of agricultural and natural sources of arsenic in the area. As a result, the scope of the sampling effort has been expanded to include sampling locations upgradient of the landfill, and ditch samples from the Surprise Drain and Hylebos Creek upstream of confluences with the ditch network leading from the B&L landfill. Samples from these upstream locations will provide a more complete basis for evaluation of adjacent and downstream sediment data.

In addition to the soil sampling in ditches, Ecology called for sampling and analysis of shallow aquifer soils in the wetlands adjacent to the landfill “to show the horizontal and vertical distribution of contaminants in wetland soils".

To meet the objectives of the Plan and to address Ecology concerns, this Wetland and Ditch Sediment Sampling Plan provides for:

1) retesting of sediments and water in agricultural ditches adjacent to the landfill and in downstream ditch areas to determine if the ditch sediments or water exceed standards;
2) testing of water and sediments from ditches upgradient of the landfill and from the Surprise Drain and Hylebos Creek upstream of confluences with the ditch network leading from the B&L landfill; and
3) sampling of shallow aquifer soils in the wetlands north of the landfill to evaluate the lateral and vertical distribution of "contaminants" in wetland soils.

2.1 DITCH SAMPLING PROGRAM

The ditch sampling program consists of sediment and surface water sampling at 15 locations. Sampling locations are shown in Figure 2-1-1 and include upgradient ditches, ditches perimeter to the landfill, downgradient ditches, the Surprise Lake Drainage and Hylebos Creek. Previous sampling locations (before and after cleanup in 1991 and 1993) are shown with the proposed sampling sites in Figure 2-1-1.

One sample will be collected at each sample site with the exception of three up-gradient ditch sample sites (SS-14, SS-15 and SS-18), where three separate co-located samples will be collected. Only one of the three co-located samples will be analyzed, with the remaining two samples archived for future analysis if desired.

Ditch bottom sediment (0-2 inches) will be sampled from the ditch bottom at each of the sampling locations. Bottom sediment samples will be collected using a BMH-53 piston-type core sampler, which will allow collection of bottom sediments in saturated or submerged water conditions. If ditch conditions are dry, samples may alternately be obtained using conventional hand tools including hand shovel and/or trowel. Sampling equipment will be washed with deionized water between sites to prevent cross-contamination of samples. Duplicate samples will be collected at a frequency of one per 20 field samples. The ditch bottom sediment sampling collection and analysis matrix is shown on Table 2-1-1. Additional ditch bottom sediment samples at supplemental locations may be collected if analytical results indicate sediment concentrations are higher than sediment cleanup levels (20 mg/kg As, 390 mg/kg Cu, 25 mg/kg Pb). The location and number of supplemental samples will be selected by the project manager based on sample results and professional judgement.

Soil samples will be placed in plastic zip-lock bags. The bags will be labeled in the field with a unique sample identification number using permanent ink. The samples will be stored in coolers from the time of collection until delivery to the analytical laboratory. Soil samples will be analyzed using a laboratory X-ray Fluorescence (XRF) at Hydrometrics' Ruston, Washington Laboratory. This analytical method provides results which are comparable to standard wet chemistry methods, but at substantially reduced analytical processing time and reduced costs. XRF has been used extensively for soil metal analysis over the last 10 years at numerous EPA and State Agency projects throughout the U.S, including projects administered by the Washington Department of Ecology. These projects include the Tacoma Smelter Superfund Site and Ecology sites in Tacoma and Everett (Everett Smelter).

All sampling locations will be photographed, and marked in the field with labeled survey stakes. After the field investigation is complete, the stakes will be surveyed to accurately locate the sampling locations on base maps and provide vertical control for evaluation of surface water and groundwater flow relationships, and evaluation of contingency action alternatives. Sampling information will be recorded on field forms and all field activities and relevant observations will be documented in a project field notebook.

Surface water samples will also be collected at each of the ditch sites and used to further assess evidence for landfill or non-landfill related impacts. Surface water samples will be collected concurrently with sediment sample collection. If the ditches are dry at the time of sample collection, a separate comprehensive surface water sampling event will be conducted when water is present in the ditches. The surface water sampling collection and analysis program is shown in Table 2-1-2.

Field parameters (temperature, pH, specific conductance, turbidity and dissolved oxygen) will be measured at the time of sampling. Field meters will be calibrated prior to measurement. Meter calibration and field readings will be recorded in the field notebook and on a standard sampling form. Containers will be rinsed three times with sample water prior to sample collection. Water samples will be collected in three 500 milliliter plastic bottles. One bottle will be unpreserved for general chemistry analysis, the other two bottles will be preserved with nitric acid to a pH <2 for analysis of total and dissolved metals. The dissolved metals sample will be filtered in the field using a 0.45 micron filter. Samples will be shipped on ice to Asarco Technical Services in Salt Lake City under standard chain-of-custody protocol for analysis.

2.2 WETLAND SOIL SAMPLING PROGRAM

Subsurface soil samples will be collected from 14 soil borings (SB-100 through SB-113) and at two monitoring well locations (MW-18 & MW-19) in the wetland area north of the landfill (see Figure 2-2-1). The proposed sampling locations are designed to provide soil quality transects through wetland areas where elevated arsenic concentrations have previously been detected in groundwater. The proposed sampling locations are shown with shallow groundwater arsenic concentration data in Figure 2-2-1. Previous sampling locations are also shown on this figure.

Soil borings will be conducted using hollow stem auger drilling methods. A split-spoon sampler will be used to collect soil samples to document the subsurface lithology and provide samples for XRF analysis. Soil samples will be collected at the following intervals:

2 - 4 ft
4 - 6 ft
6 - 8 ft
10 - 12 ft
12 - 14 ft
14 - 16 ft

The 0-2 foot increment will not be sampled because past activities have shown this interval consists predominately of biomass (roots and grasses). Duplicate soil samples will be collected at a frequency of one per 20 samples. Samples will be placed in plastic zip-lock bags and stored in coolers for transport to the analytical laboratory. The soil samples will be analyzed for metals using x-ray fluorescence (XRF) techniques. The sample analytical parameter list is shown in Table 2-1-2.

Sample handling and shipping will follow procedures described in Section 2.1. The soil boring locations will be staked and surveyed to allow them to be accurately located on base maps. Soil boring logs will be filled out at the time of drilling to document sampling intervals, sample lithology, soil moisture, and sample blow counts. Surface water conditions in the wetland at the time of drilling and other relevant field observations will be documented in a project field notebook.

3.0 SITE PERIMETER MONITORING WELL PLAN

In their March 7,' 2001 letter, Ecology noted that "the presence of arsenic (and possibly other site contaminants) in the upper aquifer outside of the site is not known." Ecology stated that "a system of wells must be designed, approved by Ecology, installed and sampled as soon as possible, which will show the location of the actual outer edge of the plume(s) of contamination emanating from the site, and including enough wells within the plume(s) to track cleanup."

Based on data presented in the Review of Remedial Activities report (Hydrometrics 2001a), elevated arsenic concentrations are present in the wetland area immediately north of the landfill and in several shallow groundwater monitoring wells around the perimeter of the landfill (see Figure 2-2-1). While arsenic trends have been delineated in the higher concentration areas downgradient of the landfill, there are areas to the west and southeast with lower arsenic concentrations that are not fully bounded by the existing monitoring well network.

As discussed in the Review of Remedial Activities report, there is evidence that surrounding agricultural activities and other ambient sources of arsenic may be a contributing factor in some of these areas. Additional perimeter monitoring wells will be installed on the western boundary of the present wetland investigation area, in the agricultural fields adjacent to the landfill, and in the area to the south and east of the landfill where low level arsenic concentrations are not fully defined. The objectives of these wells are to:

1. Define the outer edges of contaminant plumes from the landfill.
2. Provide insight on whether there are other sources of arsenic and/or metals contributing to groundwater quality in these areas.

After installation and development of the monitoring wells, a complete round of water levels and water quality samples will be collected from the new and existing groundwater and surface water monitoring sites to establish current water quality trends in the vicinity of the landfill. Water quality sampling is described in Section 4.3. Potentiometric data and water quality data from the expanded monitoring network will more clearly establish the distribution of arsenic and metals in the area surrounding the landfill. However, in addition to this data, some additional characterization of contaminant flow paths immediately downgradient of the landfill will also be necessary to provide a more detailed basis for remedial design decisions.

As shown in Figure 1-1-8, groundwater from the majority of the Hydropunch holes sampled between the wetland and the landfill yielded low arsenic concentrations, suggesting that the primary flow paths are either very localized, or arsenic in the wetlands is a residual from historical loading from the landfill prior to capping. More detailed subsurface exploration is proposed along the north boundary of the landfill to define the stratigraphy and water quality in this area. A combination of shallow test pits, soil borings and/or Hydropunch sampling will be conducted in this area to assess the presence of localized flow paths (see Figure 2-2-1). Water quality samples at these locations will be analyzed for arsenic with rapid turn-around times to allow decisions on follow-up sampling to be made at the time of the field investigation. Monitoring wells may be installed at locations where arsenic concentrations and subsurface geologic data indicate the potential for primary transport pathways.

3.1 INSTALLATION OF PERIMETER MONITORING WELLS

New monitoring wells will be installed at eight locations perimeter to the landfill. Seven locations are shown on Figure 2-2-1 and include 2 wells (MW-18and MW-19) on the western side of the wetland area north of the landfill; two wells (MW-20 & WM-21) in the agricultural field to the west of the landfill; one well (MW-22) south of the landfill, and two wells (MW-23 and MW-24) southeast of the landfill. An additional monitoring well (MW-25) will be constructed upgradient of the landfill near the privately owned Gustafson well (see Figure 3-1-1) to provide additional water quality information near this private well location.

Well locations are approximate and will need to be finalized in the field with consideration given to agricultural operations, surface water drainage patterns and other field constraints. Wells in the agricultural fields may interfere with agricultural operations and therefore may need to be installed after harvest operations are complete and may need to be temporary installations.

The monitoring wells will be installed using a hollow-stem auger drill rig. All of the monitoring wells will target the upper sand unit, which forms the shallow groundwater system beneath the lowland portion of the site. Monitoring well MW-23 is located on the edge of Fife Way at the edge of the upland, and will likely encounter shallow groundwater system in till based on geologic data from existing monitoring well D-10A.

During drilling, subsurface soil samples will be collected to describe the subsurface lithology and provide samples for XRF analysis. Soil samples will be collected using a split spoon sampler. Sample collection, handling and analysis will be performed as described in Section 2-2 for the wetlands soil sampling program. An experienced hydrogeologist will be present to log soils and oversee well construction. All drilling information including sampling intervals, lithologies, blow counts and well completion information will be recorded on Hydrometics' standard monitoring well forms.

The fine-grained sands and upward hydraulic gradients at this site tend to result in a condition commonly referred to as "running sands", in which formation sands wash into the augers when the center plug is removed from the augers for sampling or well completion. This may require addition of water, foam or other drilling fluids to the augers during sampling to offset the hydraulic head in the formation and prevent sands from filling the auger flights. In the event that drilling fluids are used during sampling and or well completion, the quantity of fluids lost to the formation will be estimated and provisions will be made to remove any introduced fluids during well development.

The monitoring wells will be constructed with 2-inch diameter flush-threaded schedule 40 PVC and factory slotted (0.020 slot) well screen. Typical screen lengths will be 10 feet; however, adjustments to screen length may be made based on field conditions encountered and the best professional judgement of the field hydrogeologist. Typical well construction details are shown in Figure 3-1-2. Anticipated well completion interval including depth and screen intervals are presented in Table 3-1-1. The actual depth and screen interval of the well will be determined in the field based on the observed subsurface geologic conditions.

The filter packs will be constructed of 10-20 silica sand and will extend to two feet above the well screen. Above the filter-pack, the well annulus will be sealed with two feet of bentonite chips and overlain by bentonite grout to ground surface. The wells will be completed with a 6-inch diameter steel protective casing and a locking cover. The protective casing will have a concrete surface seal at grade. Labels will be set in the concrete at each monitoring well site with a site-specific well identification number.

Following completion, the monitoring wells will be developed using a surge block, pump or a bailer to reduce turbidity and ensure good hydraulic connectivity with the aquifer. If drilling fluids are introduced during drilling, well develop will remove approximately 3 to 5 times the estimated volume of fluids lost to the formation. Field parameters (SC, pH and temperature) will be monitored during well development to ensure representative water quality. Following drilling and development, the new monitoring wells will be surveyed vertically to a common datum with existing wells and surface water monitoring locations.

3.2 INVESTIGATION OF FLOW PATHS ALONG THE NORTHERN PERIMETER OF THE LANDFILL

Test pits, and/or soil borings and Hydropunch sampling will be conducted at seven sites along the northern boundary of the landfill. The purpose of this task is to evaluate the presence of preferential flow paths from the landfill along the northern boundary. The test sites are shown in Figure 2-2-1 and will be located between previous hydropunch sampling locations. Soils data will be collected at each location by excavating shallow test pits to the water table or advancing soil borings.

Soils will be logged in the field and field measurements taken of specific conductivity when water is encountered to help identify areas where landfill constituents are present.

Grab samples will be collected of water from the test pits and the samples will be sent to Sound Analytical Lab in Tacoma for rapid turn-around analysis of dissolved arsenic. Based on the results, additional borings and Hydropunch sampling may be conducted in areas identified as potential transport pathways. Additional monitoring wells may also be completed in this area based on the results of this investigation. These wells would allow follow-up monitoring and aquifer testing in support of remedial design.

3.3 AQUIFER TESTING

Aquifer slug tests will be conducted at all of the new monitoring wells to estimate aquifer hydraulic conductivity. The slug tests will be performed by instantaneously removing a 1 3/4-inch diameter, 4-foot-long solid PVC rod (slug) from the well and continuously monitoring the water level recovery in the well bore. Water level fluctuations will be recorded using a pressure transducer and electronic data logger. The pressure transducer and slug will be decontaminated after each well test with a soap solution and rinsed with deionized water to prevent cross contamination between wells.

Aquifer test analyses will be conducted to evaluate the hydraulic conductivity of the shallow groundwater system. The data will be analyzed using standard graphical methods for slug test evaluation (i.e., Bouwer & Rice (1976) or Cooper, et al. (1967)) and the results compared to findings from previous investigations.

3.4 MONITORING SAMPLING AND ANALYSIS

Following completion of monitoring well installation and sediment sampling, a complete round of water quality samples will be collected from all new and existing groundwater monitoring sites at the landfill. Prior to sampling, static water level measurements will be taken at each of the wells and surface water sites. Monitoring wells will be purged and sampled using a 12-volt high-volume peristaltic pump. In order to ensure that representative formation water is collected for analysis, 3 to 5 casing volumes will be purged from each well prior to sampling and field parameters (SC, pH, and temperature) will be monitored to evaluate water quality stabilization during purging.

A full list of analytical parameters, analytical methods and reporting limits are shown in Table 3-4-1. Field parameters (temperature, pH, specific conductance and dissolved oxygen) will be measured at the time of sampling. Field meters will be calibrated prior to measurement. Meter calibration and field readings will be recorded in the field notebook and on a standard sampling form. Containers will be rinsed three times with sample water prior to sample collection. The water sample will be collected in three 500 milliliter plastic bottles. One bottle will be unpreserved for general chemistry analysis, the other two bottles will be preserved with hydrochloric acid to a pH <2 for analysis of total and dissolved metals. The dissolved metals sample will be filtered in the field using a 0.45 micron filter. Samples will be shipped on ice to Asarco Technical Services in Salt Lake City under standard chain-of-custody protocol for analysis.

4.0 GROUNDWATER CONTROL CONTINGENCY PLAN

Ecology noted in its March 7, 2001 letter to Asarco (comment 1 on page 3) that surface water quality in agricultural drainage ditches adjacent to the Site have been in excess of surface water cleanup standards for arsenic. The letter also notes that shallow aquifer groundwater arsenic concentrations in the wetland area north of the site are also in excess of groundwater cleanup standards. As a result of these observations, Ecology concluded that an on-going release is occurring and therefore requires Asarco to design and implement a contingency plan in accordance with Ecology Order No. DE-92TC-S214.

Responses to these Ecology Comments (Comment 1 Page 3) were included in the Review of Remedial Activities report (Hydrometrics 2001a). As described in these comment responses (Comment 1 Page 3), there is evidence based on existing data that arsenic concentrations in the surface water ditches may not necessarily be the result of landfill effects, but instead may reflect up-gradient ambient conditions that may either be natural or the result of the use of pesticides or herbicides associated with nearby and upgradient areas of agriculture. In addition, while existing data suggest the landfill may be a source of arsenic in groundwater in the wetlands area, it is extremely unlikely even impossible for the landfill to be the source of elevated arsenic (0.02 mg/l) observed in upgradient domestic wells such as the Gustafson well. Again review of existing literature and regional data suggest concentrations in this range may be either natural conditions or reflect low level impacts associated with agricultural practices.

The supplemental data collection efforts described in Sections 2 and 3 above will provide additional information necessary to determine the extent of any impacts on groundwater, surface water, soils and sediments that may occur from migration of arsenic from the landfill. In addition, these data will be used to develop, evaluate and implement contingency actions that address identified releases of contaminants from the landfill.

A process schematic for development, design and implementation of groundwater control contingency actions for the landfill is shown on Figure 4-1-1.

4.1 SCREENING LEVEL EVALUATION OF CONTINGENCY ACTION ALTERNATIVES

Depending on the results of the supplemental sampling and testing programs described in Sections 2 and 3 above, a range of alternative contingency actions could be implemented for the B&L landfill. These include:

- No Action
- Institutional controls
- Long-term monitoring
- Isolation and containment alternatives including:
    - Containment walls
    - Interception trenches and/or drains
    - Pumping and /or injection wells
    - In-situ treatment options
    - Pump and treat options.

An evaluation of potential contingency actions is presented in Table 4-1-1. The evaluation considers the effectiveness of the potential actions at the B&L site as well as technical feasibility, administrative feasibility and approximate costs. Generally these alternatives are supplemental to the sediment excavation, landfill consolidation and capping actions previously implemented at the B&L Site which have improved groundwater and surface water quality at the Site (Hydrometrics 2001a). In addition to excavation, consolidation and capping, institutional controls and long-term monitoring actions have also been implemented at the site and are on-going.

The evaluation in Table 4-1-1 also includes source removal/off site disposal alternatives for comparison purposes. Off-site disposal was considered by Ecology in its 1991 Final Cleanup Action Plan (CAP); however, the CAP concluded this alternative was priced substantially and disproportionately higher than other feasible options. As described in the review of Remedial Options Report (Hydrometrics 2001a, Section 2.4.2), the Washington State Dangerous Waste Regulations (Chapter 173-303 WAC) has since been changed allowing dangerous waste to be disposed in a properly design solid waste landfill. As shown in Table 4-1-1, solid waste disposal would be considerably less costly than hazardous waste disposal; however, it is still substantially and disproportionately higher than other feasible contingency action options.

Based on the screening level evaluation, no action, infiltration trenches and off-site disposal options are dropped from further consideration. The remaining potential contingency actions are combined to form contingency action alternatives and are described further in Section 4.2. Testing to determine the effectiveness of these alternatives at the B&L Site are described in Section 4.3.

4.2 DESCRIPTION OF PROPOSED ACTION

The conceptual design for potential contingency actions at the B&L landfill are presented on Exhibit 1. These actions include groundwater control interception systems, and passive and active groundwater treatment systems. The evaluation, development and implementation of these contingency alternatives is contingent on the results of supplemental data collection efforts described in Sections 2 and 3, as well as design specific data evaluation efforts described below. This evaluation, development and evaluation process is summarized in Figure 4-1-1.

4.2.1 Groundwater Interception Systems

Exhibit 1 shows conceptual designs for interception and control of groundwater in the B&L landfill. Three general interception systems are being considered:

- A trench drain interception system
- Slurry wall system
- The existing landfill monitoring and control system.

4.2.1.1 Groundwater Interception Trench Drain System

An interception trench train would be installed on the perimeter of part or all of the landfill to minimize the potential for migration of water to adjacent agricultural ditches and/or to minimize the potential for recharge to the landfill from upgradient groundwater.

Groundwater from inside the landfill would be diverted by the interception drain system to the north end of the landfill for groundwater treatment (either active ex situ or passive in situ treatment; see Section 4.2.2). Pending design analysis, an upgradient ditch interception system could be used to divert incoming recharge from upgradient groundwater (see Exhibit 1).

The necessity, development and design of groundwater diversion systems will be evaluated based on the results of the investigation efforts described in Sections 2 and 3 above (see Figure 4-1-1). If evaluation of ditch and sediment quality indicate groundwater from the landfill has minimal effects on ditch and sediment water quality or that upstream water quality is the source of arsenic concentrations observed in the ditch, then groundwater diversion systems may not be implemented. In this situation, groundwater contingency actions would focus primarily on passive treatment systems at the north end of the landfill (see Section 4.2.2).

Figure 4-2-1 shows preliminary design concepts for the interception drain system. In general, an interception trench would be excavated through the upper sand or silty sand aquifer. Where possible the trench would be keyed into the underlying silt unit. The trench would be excavated using conventional trench box techniques or using a biodegradable guar to hold the trench from caving or from in-flowing sand until construction is completed.

4.2.1.2 Slurry Wall or Sheet Pile Wall

An alternative to the trench drain system is construction of a slurry wall or sheet pile wall to isolate the landfill from the adjacent agricultural ditches or for upgradient and downgradient control of groundwater associated with the landfill (see Exhibit 1). While a slurry wall may provide a barrier to incoming or outgoing groundwater flow, it may not completely isolate the landfill from upward inflow of groundwater. As a result, dewatering systems in combination with the use of a slurry wall or sheet pile wall may be necessary to achieve groundwater control design objectives. However, as described above, the necessity, as well as the development and design of a slurry wall groundwater control contingency action will need to be evaluated pending results of investigation efforts described in Sections 2 and 3.

4.2.1.3 Existing Landfill Water and Drainage Line/Sump System

An alternative groundwater control system is use of the existing landfill water monitoring system (see Exhibit 1). As described in Section 2.4.3 of the Review of Remedial Activities report (Hydrometrics 2001a), the existing landfill water monitoring system was constructed with a horizontal and a vertical component (Figure 1-1-2). The horizontal component consists of three laterals of 6 inch ADS slotted pipe wrapped with geotextile and surrounded by a continuous gravel drainage layer. The laterals connect to a sump beneath the center of the landfill mound and were placed in trenches excavated to the silt layer surface extending from the sump, in the center of the mound, to the edge of the woodwaste limits. The vertical component of the monitoring system consists of a standpipe of approximately 40 feet of 12-inch ADS pipe extending from the sump to above the landfill surface.

It may be possible to control groundwater migration through the landfill by pumping the existing sump. Groundwater flow to the sump would be enhanced by the existing laterals to the sump. As part of the contingency plan, the effectiveness of the existing system will be evaluated by an on-site pumping test and groundwater and flow transport modeling. Groundwater level in the landfill would be monitored at the pumping sump and in the landfill vents (see Exhibit 1). Pending evaluation of this data (see Figure 4-1-1) modifications to the sump may be developed, designed, and implemented. It may be necessary to deepen the sump to enhance its effectiveness as a groundwater control point. If the existing fill monitoring system is used for groundwater control, discharge could be routed to a conventional water treatment plan or to a passive in-situ water treatment system as described below in Section 4.2.2.

4.2.2 Groundwater Treatment System

Exhibit 1 also shows conceptual designs for treatment of groundwater in the B&L landfill. Three groundwater treatment systems are being considered:

- An in situ air sparging treatment system
- A permeable reactive barrier in situ treatment system
- An ex-situ water treatment plant.

4.2.2.1 Air Sparge System

Air sparging for in situ treatment of arsenic has been pilot tested by Hydrometrics at the East Helena Superfund Site in Montana (Hydrometrics 2001b). Pilot scale testing and subsequent on-going laboratory and pilot scale test has shown that air sparging can be effective in removing arsenic from groundwater. As described in several previous investigations at the site, arsenic mobility from the landfill is controlled by the redox conditions of groundwater at the site. In particular the reduced species of arsenic (As^{+III}) are more mobile than the more oxidized form (As^{+V}). Pilot and laboratory testing has shown that conversion of arsenic III to arsenic V enhances removal of arsenic from groundwater through several physical and geochemical mechanisms including: adsorption and coprecipitation with hydrous iron oxides/hydroxides. It is believed that the relatively high iron concentration associated with Site groundwater will enhance removal of arsenic by coprecipitation/adsorption when groundwater is oxidized by air sparging.

The conceptual design for a groundwater air sparging system is shown on Exhibit 1. Air sparging could be implemented by the use of air sparge injection wells constructed in the down gradient path of groundwater flow. An alternative is to use sparge points installed in a treatment wall or vault (see Exhibit1). Groundwater would be allowed to flow naturally through the landfill to the treatment area, or could be routed to the treatment area by groundwater interception control systems as described in Section 4.2.1.

4.2.2.2 Permeable Reactive Barrier System

In situ treatment of groundwater by permeable reactive barriers (PRBs) has been demonstrated for the removal of organic and inorganic constituents. It has been tested for arsenic removal on a laboratory scale and has been shown to effective in removal of arsenic from groundwater. However, it has not yet been demonstrated on a field scale for arsenic. The USEPA is presently in the process of evaluating PRB technology for in-situ treatment of arsenic in groundwater at the East Helena Superfund site. It is expected results from these evaluations would be available and potentially applicable for evaluation of PRBs at the B&L site.

The conceptual design for a permeable reactive barrier wall system is shown on Exhibit 1. Zero valence iron could be installed as a treatment wall, or as part of a more focused funnel and treatment gate system. As a treatment wall, groundwater from the landfill would be allowed to flow naturally through the treatment area. Groundwater could also be routed through the use of groundwater interceptions control systems as described in Section 4.2.1 above.

4.2.2.3 Above-Ground Water Treatment Plant

Treatment of groundwater at the B&L Site using a water treatment plant was evaluated by Hydrometrics in 1992 (Hydrometrics 1992b). The objective of the evaluation was to establish if applicable pre-treatment standards for Pierce County and Tacoma (see Table 4-2-1) could be met using a water treatment plant. Assuming the standards could be met, the treated effluent could be discharged to the City of Tacoma POTW. The conclusion of laboratory testing showed that seasonal groundwater encountered at the B&L landfill can be treated to meet pre-treatment requirements for discharge to a POTW.

The conceptual location of a water treatment facility is shown on Exhibit 1. Groundwater from the landfill would be pumped to the water treatment facility building using the existing or modified fill water monitoring system (see Section 4.2.1.3). Based on design of a temporary facility in 1992, the conceptual design for the treatment plant is shown in Figures 4-2-2 through 4-2-5. A more detailed discussion of the water treatment evaluation is in the 1992 treatment evaluation report (Hydrometrics 1992b). It should be noted that although the conceptual design is based on treatment of 30 gpm, the actual flow rate that would need to be treated is unknown.

4.3 DEVELOPMENT DESIGN AND IMPLEMENTATION OF GROUNDWATER CONTROL CONTINGENCY ACTION

As previously discussed, Figure 4-1-1 shows the process for development, design and implementation of groundwater control contingency actions for the Site. This process is contingent on the results of ditch sediment, wetland soil and groundwater supplemental investigation efforts described in Sections 2 and 3. The development and design process is also contingent on supplemental data that addresses Site specific conditions relative to groundwater interception systems, air sparging treatment systems, and permeable reactive barrier treatment systems.

Laboratory bench-scale testing of proposed groundwater treatment alternatives will be conducted as part of the Groundwater Control Contingency Plan. The overall objective of bench-scale testing is to provide data for a comprehensive evaluation of the three selected treatment options (pump and treat, air sparging, and permeable reactive barrier technologies). Following the evaluation of alternatives and selection of the contingency action, bench-scale data will also be used to support engineering design and preparation of plans and specifications for the groundwater interception and treatment system.

Testing of groundwater treatment options in the laboratory is intended to address the following specific questions about each technology:

[1] Does the treatment work (i.e., can the treatment be used to reduce arsenic concentrations in groundwater)?

[2] How well does the treatment work (i.e., is the treatment able to achieve required arsenic concentration limits in groundwater)?

[3] Are there any other limitations on applicability of the treatment to the groundwater system at the B&L Landfill (i.e., long-term stability of arsenic removed to solid phases in the aquifer, potential operation and maintenance questions such as clogging, etc.)?

While field-scale testing is necessary to more definitively answer these questions, bench-scale testing can be used to “troubleshoot” treatment options, and to identify potential significant problems and possible solutions prior to field-scale implementation. Bench tests thus allows more efficient selection and testing of options on a large scale. Each of the three treatment options under consideration for the B&L Landfill has a demonstrated ability to remove arsenic from water. The following sections describe in general terms available data and proposed bench-scale and field testing for each treatment option. Bench-scale testing of pump and treat technology for B&L Landfill groundwater has already been conducted, and the results are discussed in Section 4.2.2.3.

4.3.1 Supplemental Data for Air Sparging

Recent air sparging pilot tests at the East Helena Superfund Site in Montana (Hydrometrics 2001b) have shown that air sparging can result in significant arsenic removal from groundwater (up to 90% removal rates) given proper redox conditions and sufficient concentrations of dissolved iron in groundwater. Air sparging increases the oxidation state of the groundwater and removes arsenic through coprecipitation/ adsorption of arsenic with hydrous iron oxides/hydroxides. Groundwater within the B&L landfill has high concentrations of dissolved iron and is amenable to this treatment method. Arsenic loss was observed during earlier bench scale testing at this site between the time of sampling and testing simply due to incidental oxygenation of the water sample during sample collection and shipping. This suggests that intentional oxygenation of groundwater by air sparging would be effective in arsenic removal.

4.3.1.1

Bench Scale Testing

Additional bench testing will be conducted to specifically evaluate the applicability of air sparging as a treatment technique for this site. The purpose of this testing is to: 1). determine the arsenic removal rates that can be achieved by introducing air to the groundwater system; and 2) evaluate operational parameters for the sparging system.

Bench testing will be performed using site groundwater and soils. This will require collecting site groundwater and maintaining the sample under the ambient redox conditions for the groundwater system prior to testing. Since ground water at the site has high bicarbonate, dissolved iron concentrations, and low dissolved oxygen concentrations, the water quality will be readily altered by any exposure to air during sample collection. Special handling will be required to minimize any direct exposure of water to the atmosphere. If problems with maintaining ambient chemistry cannot be avoided then bench testing may need to conducted at the Site.

The initial round of testing will consist of batch tests in which water samples are placed in a jar and aerated. Water samples before and after aeration will be analyzed for arsenic and iron to determine relative removal rates. Based on these results a column test may be run using representative soil from the site. Oxygen will be introduced to the water as it is injected to the column. Flow rates through the column will be designed to approximate actual groundwater flow rates. This may provide a more realistic assessment of reaction rates, and physical design parameters.

4.3.1.2 Field Testing

The need for field testing of an air sparging system is unknown at this time but will be determined based on results of bench-scale testing and preliminary design of an on-site system. If conducted, field testing would most likely focus on providing performance data under actual field conditions.

4.3.2 Supplemental Data for Permeable Reactive Barrier Treatment

Permeable reactive barriers (PRBs) constructed with zero valence iron (i.e., iron metal or Fe(0)) have been shown in laboratory and field trials to be effective in removal of metals such as chromium from groundwater (EPA, 1998). Several studies (Su and Puls, 2001; EPA 1998) have demonstrated that iron PRBs can effectively remove arsenic (both arsenite or As III and arsenate or As V) from groundwater in laboratory tests. Field testing of arsenic removal from groundwater is proposed to be conducted by EPA at the East Helena Superfund Site in the future. Testing and design of an iron PRB for removal of arsenic from groundwater at the B&L Site will follow the recommendations and procedures in available EPA technical reports (EPA 1998 and 1999). Key design parameters to be evaluated will include:

- type of PRB materials (iron and native materials such as sand);
- reaction rates and residence time of groundwater within the PRB needed to meet treatment goals;
- estimated life of a PRB system.

4.3.2.1 Bench Scale Testing

Bench-scale testing will include both batch and column treatability studies. Batch studies are most suitable for screening candidate PRB materials and verifying that PRB treatment is effective for the groundwater at the Site. Batch studies will involve placement of candidate PRB materials (iron materials from available commercial sources and various proportions of sand) with groundwater in sealed containers. After shaking or mixing the containers for some interval, the groundwater will be separated and analyzed for arsenic and select chemical parameters. This process will be repeated at varying time intervals to provide information on the degree of treatment provided by various residence times.

Based on results of the batch testing, one or more column studies will be conducted to evaluate arsenic removal under conditions that more closely approximate operating conditions in the field, such as flow velocity. Column studies are useful in determining contaminant removal rates which are the basis for design parameters (such as thickness of the PRB) that determine the residence times of groundwater within the PRB.

4.3.2.2 Field Testing

The need for field testing is unknown at this time but will be determined based on results of bench-scale testing and preliminary design of an on-site PRB system. If conducted, field testing of a PRB would most likely focus on testing and/or demonstrating various PRB emplacement methods (e.g. conventional excavation versus trenching machine) and providing additional performance data.

4.4 DELIVERABLES AND SCHEDULE

The contingency plan schedule is in Figure 4-4-1. It includes the schedule of deliverables listed in the Ecology March 7, 2001 letter as well as development of design documents, and on-the-ground activities associated with implementation of this Contingency Plan. Major deliverables include:

- Final Contingency Plan. In accordance with the ecology schedule, the final plan is to be submitted to Ecology, three weeks after issuance of Ecology comments on this Draft Contingency Plan. It is assumed this will include comments on the ditch and wetland sampling program (Section 2) and the perimeter well program (Section 3).
- Wetland Soil & Ditch Sediment Data Report. This report will summarize the results of the wetland and ditch sampling program and the information will be used to evaluate, develop and design contingency actions for the site.
- Perimeter Monitoring Well Sampling Data Report. In accordance with the schedule in the Ecology March 7 letter, this report will include data obtained during the perimeter program and will include updated plume maps and conclusions relative to the Gustafson well.
- Groundwater Contingency Action Design Analysis. This report presents the results of data collected as part of design efforts and will present the development and design analysis for the selected actions. The report will also include a detailed schedule for implementation of selected contingency actions.
- Contingency Action Plans and Specifications. Based on the Design Analysis, Plans and Specifications for the selected contingency action will be prepared.

5.0 REFERENCES

EPA, 1998. Permeable Reactive Barrier Technologies for Contaminant Remediation, EPA/600/R-98/125, September 1998.

EPA, 1999. An In Situ Permeable Reactive Barrier for the Treatment of Hexavalent Chromium and Trichloroethylene in Groundwater, EPA/600/R-99/095a through c, September 1999.

Hydrometrics, Inc., 1992a. Engineering Design Report, B&L Landfill Remediation, Pierce County, Washington, May 1992.

Hydrometrics, Inc., 1992a. Engineering Design Report, B&L Landfill Remediation, Pierce County, Washington, May 1992.

Hydrometrics, Inc., 1992b. Treatment of Intercepted Groundwater at the B&L Landfill, Piece County, Washington, Final Report, November 1992.

Hydrometrics, Inc. 1994. Closure Report B&L Landfill. Prepared for Asarco Inc. May 1994.

Hydrometrics, Inc., 1999. Hydrologic Data Summary B&L Landfill Milton, Washington. Prepared for Asarco Inc. December 1999.

Hydrometrics, Inc., 2001a. Review of Remedial Activities at the B&L Landfill – Draft-May 2001.

Hydrometrics, Inc., 2001b. Interim Measures Air Sparging Pilot Test Report

Kennedy/Jenks/Chilton and AGI, 1990. Focused RI/FS B&L Woodwaste Site. Prepared for Murray Pacific.

Su, C. and R. Puls, 2001. Arsenate And Arsenite Removal By Zerovalent Iron: Kinetics, Redox Transformation, And Implications For In Situ Groundwater Remediation. Envir. Sci. And Technol.

USGS, 2000. United States Geological Survey Release, May 8, 2000. National Analysis of Trace Elements – Arsenic in Groundwater Resources of the United States.

Washington Department of Ecology, 1991. Final Cleanup Action Plan B&L Woodwaste Site Milton, Washington. October 1991.

TABLES AVAILABLE AT
INFORMATION REPOSITORIES

FIGURES AVAILABLE AT
INFORMATION REPOSITORIES